

**REMARKS**

In response to the objection, the specification and Abstract have been amended to incorporate appropriate headings in accordance with USPTO guidelines. Withdrawal of the objection is respectfully requested.

Claims 1, 6, 9 and 15-17 were rejected under 35 U.S.C. § 102(b) as being anticipated by Schubert et al (DD 278 449 A1).

The Examiner cited DD '449 as teaching an apparatus and method for making a spark plug, which includes preliminarily bending metal strip (9) toward a spacer so as to form an arc portion in the metal strip, and then forming a gap-distance between the metal strip and the firing end of the center electrode by applying force to the metal strip. As to claim 17, the Examiner relied on DD '449 as teaching an apparatus including means for preliminarily bending and means for forming a gap-distance between the metal strip and the firing end of the center electrode.

Applicants traverse, and respectfully request the Examiner to reconsider in view of the amendment to claims 1 and 17, the English translation of DD '449 submitted herewith and the following remarks.

As described at page 5, lines 11-15 of the English translation of DD '449, "During bending, the spark plug insert (12) is pushed back into the receptacle (14). As in this connection only the clamping forces of the clamping piece (13) have to be overcome, no forces destructive to the spark plug insert arise".

One of ordinary skill in reading the above passage of DD '449 would understand that wedge piece (5) moves and contacts the center electrode of the spark plug during bending of the earth electrode.

To clearly distinguish over DD '449, claim 1 has been amended to recite the step of positioning a spacer above a firing end of the center electrode so as to make a clearance between the spacer and the center electrode. Furthermore, claim 1 has been amended to further require preliminarily bending the metal strip toward the spacer without the spacer contacting the center electrode. Support is found, for example, at page 10, lines 11-21 of the specification and in Figs. 3 and 4. See clearance (d) between the spacer 3 and the center electrode  $W_1$ . Corresponding amendments have been made to apparatus claim 17.

DD '449 does not teach or suggest making a clearance between the spacer and the center electrode and bending the metal strip towards the spacer without the spacer contacting the center electrode as claimed in amended claim 1. With respect to apparatus claim 17, the function of the claimed positioning means is to position a spacer above a firing end of the center electrode so as to make a clearance between the spacer and the center electrode. Moreover, the function of the claimed means for preliminarily bending is to bend a metal strip towards the spacer without the spacer contacting the center electrode. As discussed above, DD '449 does not perform the functions of the claimed positioning means and means for preliminarily bending, and therefore does not meet the above two means-plus-function limitations of claim 17.<sup>1</sup>

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<sup>1</sup> Application of prior art reference to a means-plus-function limitation requires that the prior art element perform the identical function specified in the claim. MPEP §2182, pg. 2100-220 (Feb. 2003).

To the contrary, as discussed above, one of ordinary skill in the art in reading DD '499 would understand that wedge piece 5 moves and contacts the center electrode of the spark plug during bending of the earth electrode.

In view of the amendment to claims 1 and 17 and the above remarks, it is respectfully submitted that the present claims are not anticipated by DD '449, and withdrawal of the foregoing rejection under 35 U.S.C. § 102(b) is respectfully requested.

Withdrawal of all rejections and allowance of claims 1-21 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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DD 278 449 A1

**Device for bending the earth electrode of spark plugs**

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(55) slotted, spring-mounted wedge piece, fork-shaped fixing element, fork-shaped support element, spring-mounted bending roller, elastic clamping piece, bending device, earth electrode, spark plug

- 10 (57) The invention relates to a device for bending a metal piece. It can be used for bending the earth electrode of spark plugs. The essence of the invention consists in that a slotted, spring-mounted, vertically displaceable wedge piece is provided as the bending
- 15 tool, that the fork-shaped fixing element and the fork-shaped support element, which in the working position bears positively against the housing, are arranged on the horizontally displaceable slide, the bending roller is mounted in a sprung manner in the direction of the
- 20 centre line of the spark plug, and that the spark plug insert is vertically displaceable by virtue of the arrangement of the elastic clamping piece.

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**Patent Claim**

1. Device for bending the earth electrode of spark  
plugs, comprising a holding device for the spark plug,  
5 actuating means for a pivotable bending roller and a  
bending tool, characterized in that a slotted, spring-  
mounted, vertically displaceable wedge piece (5) is  
provided as the bending tool, in that the fork-shaped  
fixing element (11) and the fork-shaped support element  
10 (10), which in the working position bears positively  
against the housing (6), are arranged on the  
horizontally displaceable slide (1), the bending roller  
(20) is mounted in a sprung manner in the direction of  
the centre line of the spark plug, and in that the  
15 spark plug insert (12) is fastened vertically  
displaceably in the receptacle (14) by virtue of the  
arrangement of the elastic clamping piece (13).
2. Device for bending the earth electrode of spark  
plugs according to Claim 1, characterized in that the  
20 opening of the slot (8) in the wedge piece (5)  
corresponds to the width of the earth electrode (9),  
and the slot (8) has run-in sloping surfaces.
3. Device for bending the earth electrode of spark  
plugs according to Claim 1 and 2, characterized in that  
25 the fixing element (11) has the sloping surface (23).
4. Device for bending the earth electrode of spark  
plugs according to Claims 1 to 3, characterized in  
that, below the wedge piece (5), the compression spring  
(7) is arranged parallel to the centre line of the  
30 spark plug, and the wedge piece (5) is guided in the  
guide piece (4) and connected to the slide (1) via the  
plate spring (3).
5. Device for bending the earth electrode of spark  
plugs according to Claims 1 to 4, characterized in that  
35 the elastic clamping piece (13) in the receptacle (14)  
is a rubber ring.

Accompanied by 1 page of drawings

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### Field of the invention

The invention relates to a device which bends a metal electrode from a vertical into a roughly horizontal position. The device is used in the manufacture of spark plugs, in particular where use is made of automatic sparking-plug assembly machines.

### Characteristics of the known state of the art

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In the manufacture of spark plugs, the gap between the earth electrode and the central electrode of the spark plug is set in the range between 0.4 and 1 mm depending on the intended use. This setting takes place in two steps. In the first step, the earth electrode is prebent, and, in the second step, final gap-setting takes place. In this respect, the degree of prebending achieved in the first step is of decisive importance in practice. If the earth electrode is optimally prebent, the gap-setting can be effected using a significantly smaller force. The bending distance is likewise considerably reduced. As a result of the force for gap-setting being reduced, the loading of the central electrode and of the spark plug ceramic is also reduced. Several devices for bending earth electrodes are known. In DD-WP 108857, a device is described, in which the actuating means for the bending roller and the counterstay are designed as a lever connected to a drive and are mounted at a common pivot which is displaceable in the direction of the axis of the holding device and is located on a straight line which intersects the axis of the holding device at the tip of the spark plug central electrode at an angle of 10° to 55°. With this device, the idle time of the automatic assembly machine was reduced in comparison with the known bending devices, and the output of good spark plugs rose. In practice, this device makes it possible to achieve a bending angle of roughly 30° in an automatic assembly machine. For gap-setting, during

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which the bending angle approaches zero, considerable force still has to be applied for bending at this inclination. This force, which acts directly on the central electrode via the gap gauge, can give rise to stresses and cracks in the insulating body tip, which can lead to the failure of the spark plug.

#### Aim of the invention

- 10 The aim of the invention is to minimize the rejects occurring during the bending of the earth electrode for setting the spark gap.

#### Disclosure of the essence of the invention

- 15 The object of the invention is to develop a device for bending the earth electrode of spark plugs, which has a holding device for the spark plug, actuating means for a pivotable bending roller and a bending tool and with which the bending angle is smaller than 30° when used on an automatic assembly machine. According to the invention, the object is achieved by virtue of the fact that a slotted, spring-mounted, vertically displaceable wedge piece is provided as the bending tool, that the fork-shaped fixing element and the fork-shaped support element, which in the working position bears positively against the housing, are arranged on the horizontally displaceable slide, the bending roller is mounted in a sprung manner in the direction of the centre line of the spark plug, and that the spark plug insert is fastened vertically displaceably in the receptacle by virtue of the arrangement of the elastic clamping piece. It is advantageous that the opening of the slot in the wedge piece corresponds to the width of the earth electrode, and the slot has run-in sloping surfaces. The earth electrodes are guided in the slot during the bending operation and can thus be bent centrically in relation to the centre line of the spark plug. It is furthermore advantageous that the fixing

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element has a sloping surface. On reaching the working position, the spark plug housing is fixed vertically, and the support element engages positively, acting as a stay, on the housing. It is also advantageous that, below the wedge piece, the compression spring is arranged parallel to the centre line of the spark plug, and the wedge piece is guided in the guide piece and connected to the slide via the plate spring. During the bending operation, the wedge piece is moved in the direction of the spark plug housing and lies on the end face of the housing. During bending, the spark plug insert is pushed back into the receptacle. As in this connection only the clamping forces of the clamping piece have to be overcome, no forces destructive to the spark plug insert arise. After the bending operation is completed, the wedge piece can take up the starting position again. Lateral displacement of the wedge piece is prevented by the arrangement according to the invention. A rubber ring is expediently used as the clamping piece in the receptacle. With the device according to the invention, the bending angle of the earth electrode can be kept very small without appreciable loading of the spark plug insert. A much smaller force is required, with a smaller bending distance, for setting the spark gap. Damage caused to the spark plug insert during setting of the spark gap can thus be significantly reduced.

#### Illustrative embodiment

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The invention is explained in greater detail below by means of an illustrative embodiment.

Fig. 1 shows a front view of the device, partly in section.

The slide 1, with the slide guide 2, the plate spring 3, the guide piece 4 and the wedge piece 5, is arranged in a horizontal position at right angles to the centre



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line of the spark plug. Below the wedge piece 5, the compression spring 7 is fastened parallel to the centre line of the spark plug. Located above the wedge piece 5 is the slot 8 with the width of the earth electrode 9.

5 The fork-shaped support element 10 and the fork-shaped fixing element 11 are fastened to the slide 1 in the region of the spark plug. The spark plug is positioned with the spark plug insert 12 in the elastic clamping piece 13 in the receptacle 14. A rubber ring is

10 provided as the clamping piece 13. The pivot arm 15, with the compression spring 16, the guide slot 17, the guide pin 18 and the guide rod 19 with the bending roller 20, is mounted pivotably about the axis 21.

15 The device functions as described below.

On a revolving table (not shown in greater detail), the spark plugs are positioned in the receptacles 14. When the receptacle reaches the bending station, the slide

20 1, with the fixing element 11 and the support element 10, is pushed in arrow direction 22 over the housing 6 of the spark plug. In the process, lateral centring of the housing 6 takes place. The housing 6 is pressed into a defined position in arrow direction 24 by the

25 sloping surface 23 of the fixing element 11. At the same time, the support element 10 engages positively in the contraction groove 25. However, the housing 6 can also be supported at the hexagon of the housing 6. In this position, the pivot arm 15 is pivoted in in arrow

30 direction 26. The bending roller 20 bends the earth electrode 9 in arrow direction 26 into the slot 8 and in doing so presses the wedge piece 5 sprung by the compression spring 7 onto the end face 27 of the housing 6 of the spark plug. The force component in

35 arrow direction 24 arising during this is taken up by the support element 10. The spark plug housing 6 arranged loosely on the spark plug insert 12 is held and supported in its position. The spark plug insert 12 is pushed back in arrow direction 24 after the clamping

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force of the rubber ring has been overcome. After the required bending angle has been achieved, which can be set by means of the design of the wedge piece 5, the pivot arm 15 pivots back in arrow direction 28. At the same time, the slide 1 moves back in arrow direction 29 to such an extent that the spark plug is exposed. The working cycle is completed, and a new spark plug is brought into the working position by onward movement of the revolving table. In practice, with the device according to the invention, a bending angle of roughly 10° can be achieved without difficulty.